DESCRIPTION

UNDERGROUND VAULT FOR TELECOMMUNICATIONS MICRO-CELLS

Field of the Invention

The present invention relates generally to enclosures for electronic equipment and, more particularly, to a micro-cabinet or vault that facilitates the underground storage of electronic equipment, such as instrumentation for wireless telecommunications transceiver systems.

Background of the Invention

Public demand for wireless telecommunications has grown at a tremendous rate. An increasing number of people rely on their wireless phones for an increasing number of uses including voice, messaging, data, video, and internet access. This enormous public demand has in turn fueled the need for additional carrier antenna sites to provide expanded wireless coverage to communities.

As the need for additional antenna sites has grown, so too has the installation restrictions set by many municipalities. Cell phone carriers are being required to place their transceiver equipment in an aesthetically pleasing manner. In many municipalities the planning departments are unwilling to grant permit applications for unsightly tower installations. There is also a growing tendency for many of these municipalities to require even the smallest of transceiver circuitry units to be placed underground, and for the antennas to

be disguised or stealth.

A partial, but elegant, solution for many carriers has been to disguise their antennas by placing them atop of street light standards or other vertical structures, such as signs, etc., along existing right of ways. However, no such solution is currently available to cell phone carriers for burying their transceiver circuitry.

The units housing the transceiver or transmitting and receiving circuitry for wireless telecommunications systems come in different sizes, and have different power and transceiver configurations. The standard or "macro-cell" unit is a compact base transceiver station ("BTS"), which stores six (6) to eight (8) transceivers or radios requiring 1800 to 2200 watts of power. The smallest unit currently used, primarily where a mono-pole transceiver system is inappropriate, is a "micro-cell", which typically houses one (1) to two (2) transceivers requiring 170 to 600 watts of power. Currently, the vaults available to place the compact BTS's or micro-cells underground tend to be too large to be useful in right of way applications many carriers are looking to implement. Typically these vaults are made of concrete, which for strength and equipment security reasons requires thick walls and considerable overall size. Most existing vaults also include an unattractive heat exchanger that is located above ground or an underground heat exchanger that is quite costly to construct and install, and adds to the overall space needed to bury the vault. Because of their overall size, there are limits as to where these vaults can be placed.

Thus, it would be desirable to provide the wireless telecommunications industry with a vault to house micro-cells underground that is considerably smaller in size without sacrificing strength or security, and which maintains proper climate control for equipment longevity without cost or aesthetically prohibitive heat exchangers.

Summary of the Invention

The present invention is directed to an improved vault or cabinet for storage of electronic equipment, such as wireless telecommunications equipment, underground in public right of ways. In a particularly innovative aspect of the invention, the micro-cabinet of the present invention is formed of a metal weldment, preferably stainless steel, which enables it to be made comparatively small without sacrificing strength or equipment security. Because of its reduced overall size, the micro-cabinet can easily be placed in a public right of way.

In another innovative aspect of the present invention, the micro-cabinet is substantially water-tight with a self contained cooling system and a water evacuation system. The water evacuation system preferably utilizes a one-way pressure actuated exhaust valve that enables the cabinet to be submerged in water with no danger to the enclosed equipment. Alternative cooling systems utilize similar one-way valves or snorkel-type piping running up an existing vertical structure along the public right of way.

In yet another innovation aspect of present invention, the micro-cabinet includes a weight or spring assisted rack for storage of transceiver equipment in the cabinet. The weight or spring assist system provides easy access to the stored electronic equipment when maintenance or repairs are necessary.

In a further innovation aspect of present invention, the micro-cabinet is preferably buried in a public right of way adjacent an existing vertical structure such as a light standard or sign. Cabling runs from the transceiver circuitry within the cabinet up along the interior or exterior of the vertical structure to an antenna positioned on top of the vertical structure. Unlike conventional designs, the vault or micro-cabinet of the present invention can be placed in virtually any city, under any existing vertical structure, e.g., a light standard, which are mounted on or near a sidewalk, while being fully disguised, and tending to pose no hazards to pedestrians.

Other innovative aspects of the invention include the preceding aspects individually or in combination.

Other aspects and features of the present invention will become apparent from consideration of the following description taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

Figure 1 is an isometric view of a micro-cabinet of the present invention.

Figure 2 is a plan view of the micro-cabinet shown in Figure 1 with a rack of the present invention shown in a down position.

Figure 3 is a plan view of the micro-cabinet with the rack shown in a raised position.

Figure 4 is a detail view of an exhaust valve of the present invention.

Figure 5 is a plan view of an antenna site utilizing the micro-cabinet showing a cooling system alternative embodiment.

Figure 6 is an end view of the micro-cabinet showing a cooling system alternative embodiment.

Figure 7 is a plan view of an antenna site utilizing the vault of the present invention.

Detailed Description of Preferred Embodiments

Referring to figure 1, a micro-cabinet or vault 10 of the present invention is shown. The micro-cabinet 10 includes an enclosure 12 that is preferably formed as a metal weldment. In a preferred embodiment, the enclosure 12 is a stainless steel weldment. Use of a metal, such as stainless steel, advantageously allows the surrounding earth to aid in the dissipation of heat from the micro-cabinet 10 and, also, advantageously enables the micro-cabinet 10 to be smaller, without sacrificing strength or equipment security. The enclosure is preferably about two (2) feet wide by three (3) feet long by four (4) feet deep, which is extremely small when compared to conventional underground vaults, and, depending on the transceiver configuration of the unit, the cabinet may vary between two (2) and five (5) feet in length. As a

result, the micro-cabinet 10 can advantageously be placed next to or under vertical structures, such as a light standard, in existing public right of ways.

The enclosure 12 includes first and second side plates 13a and 13b, first and second end plates 14a and 14b, a bottom plate 15, and a top plate 16, which are preferably welded together. The top plate 16 includes an equipment access opening through which equipment can be loaded into the cabinet 10 or accessed for repair and maintenance. The opening is closeable by a hatch door 17. The hatch 17 includes a handle 19, a releasably lockable hinge or shock absorber-type hinge to maintain the hatch 17 in a generally vertical position, a security locking system, and a magnetic seal similar to those used on refrigeration units. The micro-cabinet 10, with its metal enclosure 12 and watertight sealable hatch 17, tends to be more watertight than conventional units, and, unlike the concrete walls of conventional vaults, the stainless steel walls of the present invention tend to minimize condensation.

Referring to Figures 1-3, the micro-cabinet 10 of the present invention preferably includes a weight assisted rack 20 mounted inside the enclosure 12 to place telecommunications equipment in the enclosure 12 and to allow easy access by maintenance personnel when repairs are needed. The rack 20 includes four (4) generally vertically positioned posts 21 and eight (8) top 22 and bottom 23 cross members. Four pulley systems 24 are mounted in the enclosure 12 adjacent the top and side plates 16 and 13a-b. Cables 26 pass through the pulleys and attach at opposing ends to a bottom cross member 23 and a weight 25. The weights 25 are of sufficient weight to cause a fully

loaded unrestrained rack 20 to rise out of the enclosure 12 as shown in Figure 3. The weights 25 are preferably 25 to 50 pounds heavier than a fully loaded rack 20, thus requiring a maintenance worker to apply 25 to 50 pounds of offset downward force to position the rack 20 and electronic equipment in the enclosure 12. Hooks or brackets (not shown) are preferably used to maintain the rack 20 in a down position as shown in Figure 2.

In an alternative embodiment, the pulley and weight system is replaced by springs. The springs are of sufficient strength such that a fully loaded unrestrained rack 20 is caused to rise out of the enclosure 12. An offset force of 25 to 50 pounds is necessary to reposition the rack 20 in the enclosure 12.

Referring to Figures 1 and 4, the micro-cabinet 10 of the present invention includes a novel water evacuation system 30 which is capable of venting any pooled water from the cabinet 10. The evacuation system 30 includes a float-type sump pump 32 located in the bottom of the cabinet 10. A pipe 33 extends from the pump 32 to exhaust valves 34 mounted to the top plate 16 of the cabinet 10. The exhaust valve 34 is a commonly known one-way, pressure-type check valve. The one-way valve 34 tends to enable the vault 10 to actually be submerged underwater (a concern to carriers) with no leakage of water into the cabinet 10 and, thus, no danger to the equipment inside.

The valve 34, as shown in detail in Figure 4, is preferably mounted within a recess 38 formed in the top plate 16 of the cabinet 10 such that the valve-seat 35 of the valve 34 is flush with the base of the recess 38. A valve

cap 36 is slidable attached to the valve body 31. The cap 36 includes slide posts 37 that are fixedly attached to the cap 36 and slidably received in stops formed on the interior of the valve body 31. In operation, the cap 35 is forced upwardly by the pressure of the water flowing through the pipe 33. The water exhausts through the holes formed between the slide posts 37. The slide posts 37 are preferably formed of a predetermined length to ensure that the cap 35 is raiseable no further than to a position where it is flush with the top surface of the top plate 16 of the cabinet 10. Optionally, the recess 38 may be covered with a perforated grate 39. Because the cabinet's 10 top surface tends to be smooth or free of protruding parts, the cabinet 10 can be freely placed in and under public right of ways without tending to pose a hazard to pedestrians.

Although the construction of the micro-cabinet 10 advantageously allows the surrounding earth to aid in the dissipation of heat from the cabinet 10, this cooling effect may be insufficient in certain climate conditions or as a result of equipment power consumption. A reduction in humidity or condensation within the cabinet may also be desirable for increased component life even when the temperature within the cabinet is being maintained at a desirable level, i.e., at or below about 100° Fahrenheit. To accommodate these potential cooling requirements, the micro-cabinet, as shown in Figure 1, includes a self contained air conditioning unit 40, such as a Model CR23 air conditioner manufactured by Hoffman, which cools and re-circulates the air within the cabinet 10 without needing to draw in air from the exterior of the cabinet 10. The air conditioner 40, which is shown mounted

internally on end wall 14a, includes a low profile heat exchanger 41 mounted external to the micro-cabinet 10. A protective vent cage 42 is constructed about the heat the exchanger 41 and is attached to the end 14a of the cabinet 10. The cage 42 is formed of metal plating similar to the cabinet 10 with a perforated grate 44 covering the top of the cage 42 to allow air or water to circulate into the cage 42 to cool the heat exchanger 41. The bottom of the cage 42 includes several holes 43 formed therein to allow condensation and water to weep. The upper portion of the cage 42, above the heat exchanger 41, may optionally include a filter-type material that is permeable to water and air and semi-permeable to dirt and debris. Inclusion of such material will tend to keep the heat exchanger 41 clean and working more efficiently.

Alternatively, as shown in Figure 5, the micro-cabinet 10 of the present invention includes a cooling system that utilizes a pump 140 to draw cool air into the cabinet 10 and exhaust hot air out of the cabinet through a pair of vent pipes 141 and 142. The vent pipes would preferable extend along the interior or exterior of an existing light standard or sign pole 50. The ends of the vent pipes 141 and 142 are preferably bent over or hooded to prevent rain from entering the pipes and, thus, the cabinet 10.

Another alternative cooling system 240 for the cabinet 10 of the present invention, as shown in Figure 6, may utilize pop-up valves 234 and 235, which are similar to the exhaust valves 34 of the water evacuation system 30 shown in Figures 1 and 4. An exhaust valve 234 of the cooling system 240 is preferably a one-way, pressure-type pop up valve like valve 34. However, an

intake valve 235 is preferably a one-way, normally closed, solenoid-operated pop up valve. Like valve 34, the valves 234 and 235 of this alternative cooling system 240 are preferably mounted in recesses 238 formed in the top plate 16 and preferably pop-up flush with or below the top surface of the top plate 16. In operation, the solenoid-operate intake valve 235 is caused to open when the air condition unit 241 is activated. The pressure of the exhausting air will cause the exhaust valve 234 to open.

In operation, the micro-cabinet 10 of the present invention is preferably buried in a public right of way 60 adjacent an existing vertical structure 50 such as a light standard or sign. Cabling 70 runs from the transceiver circuitry within the enclosure 12 up along the interior or exterior of the vertical structure 50 to an antenna 80 positioned on top of the vertical structure 50. The transceiver equipment is used to transmit and receive signals in a manner understood by those of skill in the art.

Unlike conventional designs, the vault or micro-cabinet 10 of the present invention can be placed in virtually any city, under any existing vertical structure, e.g., a light standard, which are mounted on or near a sidewalk, while being fully disguised, and tending to pose no hazards to pedestrians, who might otherwise trip on an exposed unit.

While the invention is susceptible to various modifications and alternative forms, a specific example thereof has been shown in the drawings and is herein described in detail. It should be understood, however, that the invention is not to be limited to the particular form disclosed, but to the contrary, the invention is

to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the appended claims.